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RECURRENT BURNT PEAT: POTENTIAL POSITIVE FEEDBACK FOR PEAT FIRES

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SUMMARY

Peat swamp forest is a unique ecosystem with multiple functions such as timber, non-forest products and wildlife. Lately, many studies have shown the importance of peat swamp forest as provider of ecosystem services such as flooding mitigation and carbon storage. However, overexploitation of peat swamp forest has led to forest degradation and occurrences of forest fires. Repeated fires at the burnt peat have led to further deterioration of the peat areas. Hence the need to understand the flammability of the peat and factors which encourage repeated burnings. The aims of the study were to characterise the peat and to determine the relationship between the fuel thermal characteristics of the repeated burnt peat swamp forest. Peat samples were collected in compartment 99 for burnt area, and compartment 1 for unburnt area. The peat samples from both areas were obtained in February, 2014. These samples were collected using an auger at two layers of peat, i.e., at the surface and 1.5m depths. Peat samples were analyzed for thermal characteristics using Thermo Gravimetric Analyzer (TGA). It was found that the peat from repeated area was more thermally stable compared to unburnt area. This show that burnt peat thermal characteristics has been transformed to encourage further burning.

INTRODUCTION

Peat swamp forest is a unique ecosystem with multiple functions such as timber, non-forest products and wildlife. Lately, many studies have shown the importance of peat swamp forest as provider of ecosystem services such as flooding mitigation and carbon storage. However, overexploitation of peat swamp forest has led to forest degradation and occurrences of forest fires (Ainuddin *et al.,* 2006). Forest fire occurrence is usually due to several reasons combining and may be severe if not being controlled entirely (Lailan *et al.,* 2004). It is considered as one of the factors which alter the environment and deterimine vegetation. The burning of a large scale biomass will directly change the landscape and vegetation composition (Ainuddin and Goh, 2010) which give rise to succession process to start. Tsoi (2009) stated that the implication of biomass burning will affect the chemical composition in the atmosphere as well as global carbon cycle. Species such as *Macaranga spp. and Imperata cylindrica* can dominate the burned areas. The loss of high value timbers, herbs, habitat and wildlife are totally inevitable once fire occurs.

Fuel characteristics are essential in understanding the dynamics of forest fire as the availability and fuel composition must be known. The fuel physical characteristics can be done by determining the species of the fuel available in the forest as well as the fuel load. Determination of its fuel moisture content (FMC) is significant to address the flammability, flame and rate of spread (ROS) of that particular fuel. The calorific values of the fuel will indicate the energy released during combustion. The higher calorific value, the potential of the species for fuel is higher. The fuel characteristics will contribute to the flammability of each fuel type. Flammability is defined as the ability of a matter to be ignited and burned which consist of three main elements: ignitibility, combustibility and sustainability (Gill and Zylstra, 2006). All these three elements are the summary of all the forest fuel characteristics. Therefore, there is a need to obtain this information in order to manage, control and suppress the spread of devastating fire in repeated burnt peat swamp forest.

METHODOLOGY

Raja Musa Peat Swamp Forest has a tropical climate (16 m above sea level) with mean annual rainfall of over 200 cm per year and average temperature of 28°C. The peat substrate is several meters deep, and is continually waterlogged with the forest floor flooded during rainy season. The water is acidic (pH 3–4). The vegetation is dominated by *Macaranga pruinosa*, with other abundant vegetation includes ferns (*Stenoclaena palustris*, *Nephrolepis biserrata*, *Asplenium longissimum*, *Dicranopteris* sp.), palms (*Pinanga* sp., *Ptychoraphis* sp., *Korthalsia* sp.), Pandanus (*Pandanus helicopus*), trees (*Macaranga hypoleuca*, *Campnosperma coriaceum*, *Ixora grandiflora*, *Cryptocarya impressa*, *Parartocarpus venosus*, *Aglaia odorata*), also climbers (*Pternandra galeata* and *Shorea platycarpa)* (FPDM, 1999).

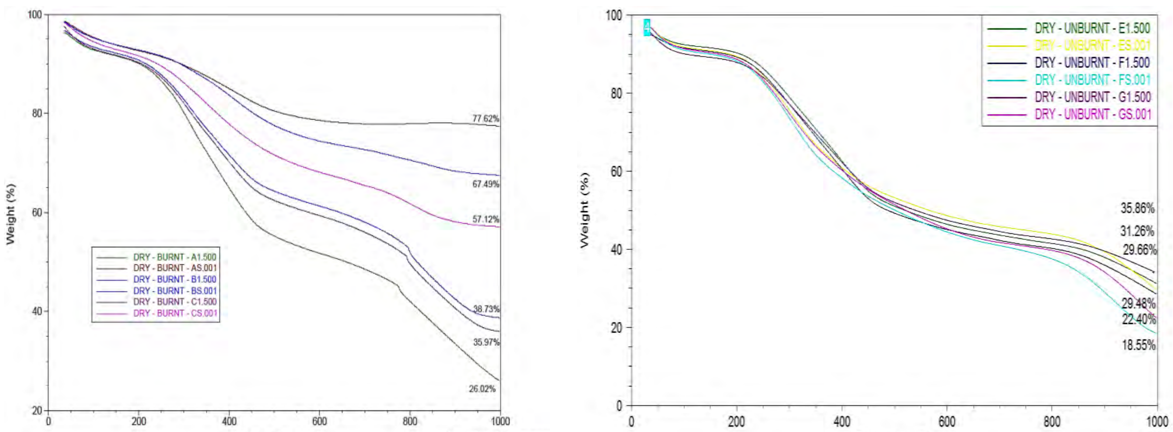
Four (4) plots of 400m^2 (20m X 20m) were established in burnt and unburnt areas. From the plots, four (4) subplots are established (5x5m) and samples were obtained peat depth from 2 depths; surface and 1.5 m depth. These samples were taken back to the laboratory for further analyses for peat thermal properties.

The peat samples were oven dried at the Soil laboratory, Faculty of Forestry. They were oven-dried at the temperature of 60˚C until the constant weight is attained (Chen and Twilley, 1999). Subsequently, the samples were grinded to pass through 40-mesh sieve size, and were sent to the laboratory of the Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia. The thermal properties of the peat were determined through the TGA. The TGA was conducted using TGA Q500 V20.13 at 10 degree/minute up to 1000°C. The results of TGA were plotted using TA universal analysis.

RESULTS AND DISCUSSION

Thermogravimetric Analysis (TGA) was conducted for the samples taken from the surface and at the depth of 1.5m of both burnt and unburnt plots. The study found that the surface area of burnt area had higher mean residue left compared to 1.5m depth of peat (Figure 1). At the surface of burnt area, the mean residue left was 67.12% while at 1.5m depth; the residues left were 33.57%. However, for the unburnt area, the residue at 1.5m depth was higher compared to the surface with mean of 32.54% and 25.533% , respectively. Generally, the study found that residue left in the burnt area was higher compared to the unburnt area. Based on the results, it showed that the burnt area was more thermally stable at the surface, and the stability was gradually reduced below the ground. Generally, the study found that the residues for both the suface and at 1.5m depth of burnt area was higher compared to the unburnt area. This indicates that it was more thermally stable in the burnt than in the unburnt area of the RMFR peat swamp forest.

Table 2 shows the process of thermogravimetric analysis for pyrolysis of burnt and unburnt area for two depths; surface and 1.5m depth. From the analysis, it was found that in burnt peat, the pyrolysis started at 360.32^{o}C (42.73 min) for surface while 262.15^{o}C (26.23 min) for 1.5 depth. For the unburnt area, surface peat pyrolysis started at 281.84°C (35.5 minutes) while peat from 1.5m depth, pyrolysis started at 253.29°C (11.95 min). Therefore, the unburnt area took shorter time for the pyrolysis process to complete compare to the burnt area, and it was significant difference between the surface and 1.5m depth during starting of pyrolysis process. However, the surface took longer time to complete the process compared to 1.5m depth.



a. Burnt

b. Unburnt

Figure 1: Thermogravimetric analysis of burnt and unburnt peat.

Table 1: Mean of residues on burnt and unburnt peat.

	Plots	Residues (%)	Residues (mg)
Burnt	Surface (mean)	67.410	3.285
	Standard error	5.918	0.604
	1.5m Depth (mean)	33.573	1.598
	Standard error	3.859	0.143
Unburnt	Surface (mean)	25.533	1.301
	Standard error	3.259	0.173
	1.5m Depth (mean)	32.540	2.340
	Standard error	1.853	0.489

Table 2: Thermogravimetric analysis process of burnt and unburnt peat.

Area	Depth	Pyrolysis (°C / min)	
		Start	End
Burnt	Surface Mean± Standard Error	360.320±23.632/ 60.513±6.702	548.407±33.441/ 103.263±6.528
	1.5 Depth Mean± Standard Error	262.153±3.963/ 46.053±0.803	394.507±53.816/ 72.280±10.731
Unburnt	Surface Mean± Standard Error	281.837±2.952/ 49.807±0.625	459.357±6.502/ 85.313±1.299
	1.5m Depth Mean± Standard Error	253.293±5.900/ 44.253±1.184	314.773±23.631/ 56.200±4.529

CONCLUSION

The study shows that there were changes to the thermal characteristics of burnt peat. TGA shows that it has more residues with longer time for pyrolysis process. This shows that burnt peat is more thermally stable and transformed to enhance further burning. This study suggests that the thermal characteristic of burnt peat can influence the fire behavior of the recurrent burnt peat areas.

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